

XIII. *Notes on Indian ants.* By GEORGE ALEXANDER
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[Read April 3rd, 1889.]

THE following notes (which I have been encouraged to offer to the Society by the kind assurance of my friend Mr. Edward Saunders that they might be of some interest to hymenopterists) are confined to my written memoranda of a few only of the more conspicuous or interesting of the Indian species which have been constantly under my observation from March, 1872, to March, 1886.

Now that I have left India, I often feel sorry I did not turn to better account such a splendid field for the study of these most fascinating insects, but the calls and duties of a business life and the necessity of spending much of one's spare time in outdoor sports, which in India means not only relaxation but health, very greatly reduce the leisure available for steady entomological work, and, as these notes will show, almost restrict one's observations to Sundays and holidays; still there have been many neglected opportunities, and I shall always regret having failed to find the female of *Dorylus*, and to dig up a satisfactory nest of *Holcomyrmez indicus*.

Looking back on Indian ants generally, it is strongly impressed upon my mind by many an unrecorded observation that not only do different species vary as widely in habits and character as do the numerous and distinct nationalities inhabiting this wonderful country, but that individuals of the same species will occasionally exhibit, when under apparently similar conditions and circumstances, different little traits and dispositions, so that if you attempt to fix any hard and fast lines as to ant-conduct you are apt to find your calculations and theories somewhat upset.

Mr. Edward Saunders has kindly assisted me in determining some of the ant-puzzles, and I am happy

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to say that my Indian collections of Hymenoptera are now in Mr. Cameron's able hands for description.

Camponotus compressus, *Formica compressa*, Fabr. The Black Ant of India.

This species is very common in Bengal, and can be seen in numbers almost everywhere, but it becomes comparatively rare as you get up-country to Oudh, the North-west Provinces, and the Punjaub, where its place seems to be taken by *Myrmecocystus viaticus*; the two species can be taken in the same locality, but as *viaticus* becomes common, *compressus* is seen less frequently: Benares, Agra, and Lahore are good illustrations of this. *Compressus* is very common in Madras, and I have also taken it in Bombay. The nests are formed in the earth at a depth of several inches, generally under the shelter of trees, and are very populous. The sexes swarm in May or early June, and take flight as soon as the sun goes down. Stray specimens of the sexes, however, may be taken at light from the commencement of the hot weather to the end of the rains (April to September). The workers-major are very fierce and strong, and attack when disturbed with the greatest courage; if you allow them to fasten on your hand they can draw blood with ease, their strong mandibles cutting like a pair of nail-scissors; and when once they get a good hold, unless you unlock their jaws, they will leave their heads fixed in the wound rather than loosen their bull-dog grip.

It is amusing to watch the havoc these big workers will play with the white ants (Termites) whenever they get the chance. Very probably the trunk of the tree under which *compressus* has formed its colony will be plastered with the covered ways of Termites; take a stick and uncover these, and *compressus* will immediately rush in and carry off the soft helpless Termites to their nest; but they never have the sense or industry to open up any of these prolific finds for themselves, even when the key or start is given them, although with their immense strength they could very easily do so.

It is a very common occurrence to find evidence of deadly family feuds between these warriors, such as two lying dead, locked together, and another walking about with a big head fixed to a leg or antenna: but of many

observations of a similar character, I will relate the details of a particularly desperate fight that took place in the verandah of my bungalow in Barrackpore between a worker-major (not a very big specimen) and a nest of that pungently stinging ant, *Solenopsis gemminatus*. One afternoon in May, 1880, at 4.30 p.m., I noticed a worker of *compressus* very busy skirmishing round a column of the verandah, in which was a strong colony of *Solenopsis*; she contented herself for some time in cutting off and snipping in two the stragglers from the nest, but by-and-bye she became bolder, and came closer to the nest, seizing and cutting away with the most systematic determination; by stooping down a little you could distinctly hear the snip, snip of the mandibles as they severed heads and bodies of the apparently unoffending *gemminatus*. This went on till 5.30, when *compressus* commenced an attack on the main entrance to the nest itself; and now the fight became more general. After a rapid dash at the entrance *compressus* would retreat, covered with these little red ants; some would be jerked off, but the more pertinacious required individual clearing, and I noticed *compressus* adopted a very clever plan of freeing her legs from the enemy: say one or more ants were holding on to her leg, she would then encircle that limb with her mandibles above the hold of the red ants, and then, instead of moving the jaws, would draw the leg through, a process very like shredding currants; of course *gemminatus* would often get a hold where this process could not be applied, but *compressus* always managed to free herself at last, and then off to the entrance again for a fresh attack. Twice while watching, *compressus*, covered with red ants, rolled from the base of the column to the steps below, but as soon as she freed herself, up she mounted again and renewed the fight. At 6 o'clock I went for the usual evening drive, and left my friend hard at it. On my return at 8 the fight was still going on, although it was then dark, and *compressus* was showing evident signs of exhaustion. At 9.30 I went out again to see how matters stood, and found *compressus* still alive, but covered with foes and almost done to death. I picked her up, cleaned off the red ants, brought her indoors, put her in a comfortable open box, and prepared some syrup of sugar and sherry, but on going to the box the next morning I was grieved

to find her stiff and dead. I have always regretted I did not mix her syrup with brandy or port instead of sherry, but I fear she was past recovery. After bringing her in the night before, I went back with a light and gathered up some of the dead from the battle-field, and of the odds and ends of heads and bodies. I made out next day some 53 slain, but the total must have been much greater, as I did not succeed in picking up in the defective light of a wall-lamp anything like the whole of the killed. I should be inclined to estimate the total as nearer 150 to 200. I did not observe any wounded; *compressus* did her work too effectively for that.

Beyond a pure love of a good scrimmage I can offer no suggestion as to any reason or cause for this fight; *gemminatus* was wholly unoffending, and *compressus* might have left the battle-field with colours flying any time from 4.30 up to 8 p.m. I have seen many instances of *compressus*' pugnacity when coming across other ants, or crossing close to another nest, but never such a systematic, determined affair as the one described. I have this Hereward of ants in my collection now, with a few odds and ends of the slain. I have examined a great many nests of *compressus*, but have never succeeded in finding in them any other species of ants, Coleoptera, Aphidæ, or indeed insects of any kind.

Myrmecocystus viaticus (Fabr.).

Cataglyphis viatica.

This ant is common in the North-west Provinces, Oudh, and the Punjaub. I have also taken it in Tirhoot, but never in the Calcutta district. It forms its nests in the hard-baked earth in the most exposed situations, and seems to revel in the hot dry air and fierce sun of these parts. You can always find plenty of nests in the broken ground about Agra, and also in the pathways of the gardens at Benares. The workers, which vary immensely in size, can be found busy and active all the year round, but the sexes I have only obtained in May. The workers have a strong propensity for marching about in irregular lines of a dozen or twenty together; they march at a great pace, but I have never been able to detect any particular object in these excursions, and have never seen them attacking other ants, or bringing

home any plunder. The workers-major, however, are very fond of carrying their smaller brethren when on the march, which they do by striding over and holding them clear of the ground with their mandibles; if you disturb them the big worker drops the little one, and each makes off on its own account, but if left alone, and you watch quietly for a little time, you may see the big ant pick up the little one and march on again in a great hurry, and as if to make up for the delay. I have examined many of the nests of this species, but never found any slave-ants or insects of any kind in them. The big workers are powerful ants, but do not possess the immense strength of the giant workers of *compressus*.

Camponotus sylvaticus, Oliv.

This is a common species in Bengal, and can be found on most tree-trunks; it delights in shade, and forms its nests (which are never populous) in the ground under leaves. The workers are very active and extremely fragile, and it is difficult to secure perfect specimens. Specimens even from the same nest will vary greatly in colour.

Polyrhachis levissimus, Sm.

This ant forms its nests in the decayed wood of trees, covering the entrances to its burrows with a thick papyraceous material, which might be best described as a "small-hands" made in the substance of a "tissue"; it is by no means a common ant, and I have hardly found half-a-dozen nests during my residence in India, and these have all been in Bengal. My finest nest is situated in a tree (a species of *Acacia*) in Barrackpore Park, on the south side of the tennis-ground, close to the Chirya Khana (aviary). This nest has a web stretched across a portion of the decayed trunk fully 18 inches broad by 2 feet in length, and is very populous; this nest swarms about the commencement of the rains, June 15th to July 7th. It is a strikingly handsome species, with its shining jet-black head and body, relieved and set off by the red legs. It often reminded me of our English *F. fuliginosa* in general appearance and habits, and always seemed like an old friend, but though I spent many hours for many years watching

this nest, I never detected any special trait or character worth recording. I never found any other species in the nest nor Aphidæ, and, as far as I could observe, the ants derived their nourishment from the rich, black, moist mould of the decaying wood. They are a gentle species of ant, and can be handled without inconvenience.

Polyrhachis Schrinax, Roger.

This ant forms its nest by binding together with one or two silky threads a couple of leaves of a shrub; it only contains a few individuals, and is decidedly rare. The same remarks apply to *Polyrhachis bicolor*, Smith.

Polyrhachis spiniger, Mayr.

This is a common species in Bengal, but the nests are not easily found; they are formed by web-work binding together a few twigs of a spiny shrub like a dwarf babool, and I have not found them in any other plant. This species was described from specimens taken in the Botanical Gardens, Calcutta.

Pseudomyrma bicolor, Guér., Sm.

Sima rufo-nigra (*nigrum*), Jerdon.

This species (the female of which is figured and described by Frederick Smith in the Entomological Transactions for March, 1875, from my specimens taken at Barrackpore) is very common in Bengal; it forms its nests in the dead (but not decayed) wood of trees, and it can always be met with scouring over the trunks, particularly of fruit-trees like the mango (*Mangifera indica*), bael (*Ægle marmelos*), and lychee (*Nephelium Lichi*). Though so generally common, the nests are not easy to find, and I only met with two thoroughly well-established colonies that could be visited and watched year after year (the first was situated in a tree in Barrackpore Road, opposite the Park-gates, just where the trunk-road turns off by the Club; the other in a small tree in the Park, in some waste ground by the viceregal kitchen-garden. These nests I have spent hours in watching from 1874 to 1886). It is a very pugnacious species, and attacks almost any insect that

comes in its way; I say almost, for I have seen it distinctly avoid the big workers of *compressus*, and on one or two occasions also the workers of *Ecophylla smaragdina*, when placed at a slight disadvantage in the way of position and numbers; it is armed with a very powerful sting, which inflicts by far the most painful and lasting wound of any hymenopterous insect I am acquainted with, and I have had experience of the stings of most Indian bees, wasps, and ants. It is very possible this may be considered by many who know the ant as too high an estimate of its stinging powers, but there are stings and stings. I have had hundreds of casual ones, and thought no more of them than of the stings of a *Polistes* or *Pompilus*; but once allow this ant to get a firm hold with its mandibles, and then, doubling its body, plunge its sting, so to speak, up to the hilt, and go on stinging, and the result is an entomological experience that few would care to try again. I have had several of these little experiences, and will give the following details of the worst:—

I was out collecting in Barrackpore Park, and one of these ants got on my left hand and stung me just under a heavy snake-ring I was wearing. I was foolish enough to allow it to operate in the above-mentioned thorough fashion before I brushed her off, and never thought of removing the ring until the finger was too swollen to do so. On my return home I tried to reduce the swelling with ice, but without success; the whole hand puffed out, the inflammation extending right up the arm to the shoulder; the finger itself turned blue, and looked and felt like bursting. I spent a wretched night, and the first thing in the morning sent to the bazaar for a native jeweller (Johari), who cut the ring off for me, but it was a painful operation, and it was two days before I was quite right again. I was in perfect health at the time, and in football training, which will give some idea of the effect of the poison when *rufo-nigra* has sufficient time to make a really deliberate and well-sustained sting.

In my compound at No. 45 Cantonment, Barrackpore, I had a very fine baël-tree, covered every year with fruit, of which my mali (native gardener) was especially fond; but the tree was much frequented by *Pseudomyrma*, and little "Adjun-mali" never went up to pick the fruit

without expressing many anathemas on this particular species of ant.

I have never found any swarming time for this species, but have taken specimens of the winged female at different times during the hot weather and rains, but generally in May; but altogether I have not captured more than about twenty specimens. From May 20th to 24th, in 1879 to 1882, I captured each year a single female sitting on a leaf of the mussel-shell creeper, *Clitoria ternatea*, on the east side of the Chirya Khana (aviary), Barrackpore Park, and in almost the same position. What the attraction for this particular spot was I could never make out, and there were no nests in the immediate neighbourhood.

Wherever you find this species in any numbers, if you watch a few moments, you will see a mimicking spider, *Salticus*, running about amongst the ants, which it very closely resembles in appearance, much more so in life than in set specimens placed side by side; in my two favourite nests I have seen numbers on the most friendly footing with the ants, though I have never seen them enter their burrows. I have never seen these spiders doing anything, or capturing any fly or other insect, though they are always very busy and in a great hurry; they are very quick in their movements, and are difficult to capture, and, being very fragile, good specimens are not very easily obtained. I have at times fancied I have seen them imbibing some of the moisture from the bark where it has been bruised or chafed, but I cannot be certain; they are evidently on a special footing with the ants, and are, I should say, the only friends *Pseudomyrma* has, with the exception of a sand-wasp, a new species of *Rhinopsis* since described by Mr. Cameron, which also very closely mimics *rufo-nigra*, and which, on first observing amongst the workers, I took to be the male. It is very active; I have seen three specimens (but only captured one), two at the nest in the Barrackpore Road, and one at the nest in the Park.*

S. rufo-nigra appears to be fairly omnivorous, preying

* It is perhaps curious and worthy of remark that a species of *Ampulex* should so exactly mimic this ant and mix with it on friendly terms, whilst another species, the handsome *compressum*, should behave towards it in the somewhat overbearing and rough manner I have elsewhere described.

on live insects, such as flies, moths, other ants, or anything it can capture; it is also very fond of over-ripe fruit, and there is a species of fig in the Park, the fruit of which (about the size of a medlar) is always riddled with these ants. I have not, however, found it on carrion, as I have the workers of *Dorylus* and *Solenopsis*.

I have never observed the workers fighting amongst themselves in the immediate neighbourhood of their own nest, but on other trees it is not an uncommon occurrence to find little parties of six or eight engaged in deadly battle. In May, 1883, I found five couples locked in a death struggle on the trunk of a casuarina-tree; I secured them, and they did not let go their hold on being put in the collecting-bottle, but died as they fought. It seems probable that these were workers from different nests engaged in hunting, and a common object had brought them into collision.

S. rufo-nigra and *Ecophylla smaragdina*, Fabr.—In 1883 *smaragdina*, which had never for the previous ten years been a very common ant in Barrackpore, appeared in large numbers, and advanced from tree to tree along the trunk-road; it came up opposite the Club and the Park-gates, where the road turns round to the parade-ground and Pulta. I watched the position of affairs with much interest, as *smaragdina* had only the road to cross,—one big tree and one telegraph-post,—and they would be on to my favourite nest of *rufo-nigra*. This was in March, but it was not until April that *smaragdina* crossed the road, and I observed the workers gathering in numbers about the end big tree and the telegraph-post, but my tree was still unmolested. On Sunday, April 29th, however, the fight commenced; *smaragdina* were clustering round the tree, and making futile efforts to ascend, for *rufo-nigra* mustered in strength in a ring round the base of the trunk, and successfully repelled every effort of *smaragdina* to effect a lodgment. Ant for ant *rufo-nigra* was far more than a match for *smaragdina*, and the yellow ants were routed by the red and black. There were (as far as I could see) no killed on either side, and when I left, after watching some hours, *rufo-nigra* was master of the situation, and *smaragdina* retiring to the big tree and telegraph-post.

The next Sunday, May 6th, I again visited the tree, and to my surprise a great change had taken place in

the position of the two species. There were no yellow ants round the base of the tree, but *smaragdina* appeared in great numbers high up on the trunk on the north side, and were descending towards the red and black in the shape of a wedge, the base spreading almost across the north side of the trunk, then tapering off to a point, the apex being formed by a single ant supported by two, the two by a line of three or four, and so on. When I arrived this spear-head of ants was about two feet above the entrance of *Pseudomyrma's* nest (which was a little on the west side of the tree); it was not advancing, but almost stationary, the only movement being made by the few forming the apex: *rufo-nigra* clustered in numbers round the entrance to their nest, but did not attempt any counter move in force or combined effort; they contented themselves with light skirmishing with the point of the *smaragdina* formation, but here, though they tried many times, they could make no impression; *rufo-nigra* invariably engaged yellow ant No. 1, the apex; No. 1 instantly backed on Nos. 2 and 3 in the second line, which brought an enemy on either flank, which was too great odds, and *rufo-nigra* would have much difficulty in disengaging herself. This went on for some hours, till I had to leave. I never saw any killed, but the apex of the yellows was once or twice relieved from the rear: *rufo-nigra* was evidently much alarmed, crowding round the entrance to their nest with a restless unmeaning action and generally scared look.

I could never make out how *smaragdina* arrived at the upper part of my tree; either they must have ascended on the south-east side (which was not so much frequented), when *rufo-nigra* was not on the alert, or they must have gone up the telegraph-post and travelled along the wires, which just at one point touched a few of the leaves of my tree. The trees on the right and left of my tree did not touch.

On Sunday, May 13th, I again visited my tree, expecting to find *smaragdina* in possession, but the reverse was the case; there was not a single yellow ant on it, *rufo-nigra* being in sole charge, and the work of the colony going on as usual. What had happened in the meantime I had no means of telling, but I think

smaragdina must have left the tree of their own accord, and were not driven off.*

On Sunday, May 20th, I again went to my tree, to find another invasion of *smaragdina*, and the wedge-shaped column of yellow ants advancing as on May 6th; this time *rufo-nigra* hardly offered any opposition, and there was a very apparent diminution in their numbers.

On Thursday, May 24th, *smaragdina* had again deserted the tree, and *rufo-nigra* was to the fore.

On Sunday, June 10th, another invasion: *smaragdina* all over the tree, some workers being close to the entrance to *rufo-nigra*'s nest; very few of *rufo-nigra* workers about, and these all small-sized specimens; the red and black ants almost suppressed.

On Sunday, June 24th, *smaragdina* occupied the upper portion of the tree, *rufo-nigra* the lower, and had regained their nest.

On Sunday, July 22nd, I found *smaragdina* strongly in the ascendant: very few workers of *rufo-nigra* about.

After this date I left off taking written notes, but *smaragdina* gradually deserted my tree, and passed on to others; *rufo-nigra* was left in undisputed possession, but the colony was never so populous and prosperous again, and on my leaving India, in 1886, had not entirely recovered from these invasions of the yellow ants.

In the 'Entomologist's Monthly Magazine' for 1876, pp. 87, 88, I have very fully described a curious phase in the history of this ant, and the beautiful sand-wasp, *Ampulex compressus*; how, on the 1st June, 1876, on the trunk of an old peepul-tree (*Ficus religiosa*), on the road to Pultah and Barrackpore, I found a number of these wasps and ants engaged in a series of battles, or what really describes it more accurately, wrestling-matches, the wasps jerking the ants clear off the tree one after the other; there would be a little fencing and

* It is possible that as the spear-head formation of yellow ants advanced to a level with *rufo-nigra*'s nest, the red and black ants may have retired; it would be impossible for *smaragdina* to follow them up, as their size would not permit them to enter the burrows. The yellow column may have then passed on, and *rufo-nigra*, issuing in a body, taken them in flank, and by this skilful manœuvre snatched a victory from defeat; but of course this is mere conjecture, though more unlikely things do happen in ant-life.

dodging for a hold, especially when two ants at the same time faced a wasp, but *Ampulex* always succeeded in jerking them off the tree. The ants did not appear to be hurt, and I watched several reascend the tree and try another fall with their too-powerful opponents. This tree was always much frequented by both *Ampulex* and *Pseudomyrma*, but I have never seen any "tummasha," as the natives would call it, of this sort going on there, either before or since; but on May 20th, 1883, on a peepul-tree in Barrackpore Park, I observed a single specimen of *Ampulex* jerking ants off the trunk, mostly *rufo-nigras*, but in this case there was some apparent reason; both ants and wasps were attracted to the same spot by some sort of sticky secretion exuding from the bark, and ants and wasp consequently collided, with the result that the former were jerked off as described; only a few of the *rufo-nigras* offered any opposition or made any fight, and as before, none of the ants appeared to be much the worse for their falls.

Pseudomyrma carbonaria, Smith.

Sima carbonaria, Smith.

This species is not uncommon in Bengal, and forms its nests in trees, as with *rufo-nigra*. I have only found one or two nests, and these were not populous; my best one was situated in an india-rubber tree (*Ficus*), on the drive from Government House to the Outram Statue, Calcutta. I have only taken one specimen of the winged female. The sting of this ant is sharp and pungent, but not to be compared in power to *rufo-nigra*. There is a species of *Salticus* which mimics this ant, but it is very rare, and there is another spider which also frequents tree-trunks, and closely mimics a *Camponotus*.

Ecophylla smaragdina, Fabr.

This well-known ant is common in Bengal, and forms its nests in trees by drawing together the living leaves with a fine white web, as described in Jerdon's 'Madras Journal.' In 1883 immense numbers of this ant appeared in Barrackpore, advancing from tree to tree along the trunk-road from Calcutta, and they soon took up a strong position in the Park; some of the trees were

covered with nests, which are very populous. I noticed that the various *nests* on any *one* tree appeared to form *one colony*, and to live on friendly terms, whereas the ants on a neighbouring tree would be inimical; this I proved by keeping a nest in my verandah for several weeks at a time, and trying a few simple experiments. I found that ants brought from any nest from the same tree as my captive nest were immediately recognised as friends, and received with evident signs of satisfaction; but specimens brought from nests from any other tree were immediately attacked, and unless rescued were killed in the most savage manner. The longest test was only three or four weeks, for by that time my captive ants always began to show signs of failing health, so that I never had the heart to keep them shut up for a longer period. I tried to keep them healthy by a daily supply of fresh leaves, and fed them with sugar, plantains, and other fruits; but they took most kindly to green *Geometra* larvæ taken from newly-made nests of *Eumenes conica*, which were generally handy in the verandah, but either captivity did not agree with them, or I failed in my mode of treatment, for after the third week my captives invariably became more or less feeble and sickly. The following are extracts from my diary:—

May 6th. Brought home with me (with considerable difficulty) a fine strong nest of *Ecophylla smaragdina*, and arranged a comfortable home for it in a large open box in my verandah, isolating it by standing the box on a tin pot resting on a large brick, the brick standing in a large earthenware saucer of water.

May 24th. Introduced four ants taken from another nest, but from the same tree; these were at once received with marked signs of pleasure, were caressed, and entered the nest with their friends as if perfectly at home.

May 27th. Introduced ten specimens taken from a different tree: these at once showed signs of alarm, and endeavoured to escape; but most of them were seized, and would have been pulled to pieces had I not rescued them.

June 3rd. Introduced some more strangers, who showed alarm and immediately made off till stopped by the water; the captive *smaragdina*, though showing

signs of hostility, were too feeble to make any serious attack.

I repeated this experiment many times, varying the intervals of introducing friends and strangers from a few days up to the three weeks, but always with the same result. I then altered the conditions somewhat, and on June 10th cut a fine populous nest from a tree and placed it on the trunk of one a few hundred yards distant, inhabited by another colony. The ants from my nest immediately took possession of the fork where I had placed the nest, overpowering the few ants that happened to be about; but others came streaming down to repel the invaders. My nest continued to pour forth its swarms, and soon the trunk was covered with masses of struggling yellow ants. It was, as far as I could judge, a drawn battle.

I then withdrew my nest, and hung it up to the trunk of a tree frequented by *Pseudomyrma rufo-nigra*. Out sallied the yellow ants, and *rufo-nigra* in alarm made off, and in doing so showed a great amount of discretion; they had not the numbers to make a stand-up fight, but their superior individual strength enabled the few that were attacked to deal out some rapid and effective strokes with mandibles and sting, to wrench themselves clear and escape without injury. I then took the nest of *smaragdina* back to the tree from which I cut it, and the ants were at once received with every sign of pleasure; and, although hundreds must have been left behind on the two trees, the nest appeared to be as populous as ever.

On another occasion I hung a nest of *smaragdina* to a small Palmyra palm in my compound, which was occupied by a strong nest of the yellow wasp, *Polistes hebraeus*, but the ants and wasps did not come into contact in any way, although they were only separated about two feet. In this my observations did not agree with the late Mr. Chas. Horne's, who found that *Ecophylla* had a great antipathy to *Polistes*; and in his paper on Hymenoptera from the North-west Provinces gives a very interesting account of the attacks of the yellow ant on the yellow wasp; but in my case the ants were not quite under natural conditions, which may easily account for their leaving the wasps alone. And I was never able to find *Ecophylla* and *Polistes* inhabiting

the same tree; but I think the observation is of interest as tending to show that ants under slightly altered conditions will often show different traits of character or instinct.

During the time I kept *Ecophylla* in confinement I found they were very stupid in any efforts they made at escape; they would occasionally tumble off the brick island into the water, although within an inch would be a bridge purposely arranged for their use. When *Ecophylla* did fall in the water they collapsed and drowned at once, and seemed incapable of making any attempt to save themselves by swimming an inch or two. Some nests I kept in a large open tin-lined box, which held them securely until the tin lost its smooth surface from exposure, and allowed the ants a foot-hold, but even then they were very slow to escape.

Diacamma vagans, Sm.

This species is very common in Bengal. You never find it in large numbers, but generally singly, or two or three together; its nests, which are never populous, are usually formed under bricks, stones, or in brick-work, and always in shady situations. It appears to have no regular time for swarming; its sting is sharp, but the pain does not last more than a few seconds.

In the verandah of my bungalow at Barrackpore I had a nice little nest in the brick-work, which I watched for several years, and used to feed the workers with sugar and other sweets. I arranged a little island by means of a brick placed in the centre of a large plate filled with water, covered the brick with sugar, and then with a piece of bamboo made a bridge from the floor to the brick. I left this the whole of one Sunday, but no ants found out the treasure. The following Sunday I captured a *vagans*, marked her with paint, and put her to the sugar; she immediately seized a grain, crossed the bridge, and made off home to her nest, distant about 35 ft., in a fairly direct line. After depositing the sugar she was out again in a few seconds, made her way back to the island, took another grain of sugar (she usually selected the largest), then back to the nest. I watched about a dozen journeys, and after the first two her track was as near a straight line to the sugar as could be. A

few workers came out from her nest and stood about the entrance, but she took no notice of them. I do not know how many journeys she made that day, as I had to leave for the evening drive.

The next Sunday I arranged the sugar island in the same place. There were a good many ants of different species walking about, but none found the way to the sugar. In about an hour out came my marked ant, and after a little wandering about found the bridge, and then followed the rapid journeys to and fro with the sugar. She never appeared to eat any herself, her great desire being to get all she could stored in her nest.

The next Sunday the same process went on, but with this slight difference: this time some of her own fellow-workers seemed inclined to follow her and watch her movements, and my marked ant, after going one or two direct journeys, then altered her mode of travelling to a very irregular and zigzag course, and generally assumed a casual and uncertain air. I watched her closely, and am quite certain she wished to bamboozle her friends, and keep all the credit and "kudos" of bringing home the treasure to herself. She kept up these roundabout journeys to and from the island until I left for the usual drive.

I carried on these experiments for many successive Sundays, but no other ants from this nest found out the island. A small species of *Tapinoma* did, and came in numbers every Sunday, and at last a worker of *vagans* from another nest at the other end of my verandah, distant about 50 ft., found out the bridge, I think by accident, but had the enterprise to cross, seize a piece of sugar, and off to her nest. After this I always had a marked ant going backwards and forwards with sugar on the left side, and an unmarked ant doing the same on the right side, and little *Tapinoma* swarming all over the place with the grains, but no other ants found out the sugar island. Sometimes the two workers of *vagans* met on the brick or bridge, but never took any notice of each other; they were too much wrapt up in their work for that.

I should mention that I always arranged my island within a few feet of the same spot, and now I often wonder why I never changed the position completely, and then watched the result.

After reading Sir John Lubbock's most charming

work on ants, I thought I would try a few simple experiments to see if I could influence my ants by means of colours. I first scattered sugar about my verandah for a day or two, by which means I attracted considerable numbers of ants of different genera and species, particularly *Diacamma*, *Solenopsis*, and *Tapinoma*. I then placed sugar on different coloured cards (subsequently substituting the intensely brilliant colours of surface-papers for the cards), making various changes from time to time according to my judgment. These experiments I kept up for a good many weeks, but I could never find that colour influenced my ants in any way. I do not attach any value to this, as my experiments were very crude, and generally interrupted by the gaps of from Sunday to Sunday, and I only mention the circumstance as affording some traits of ant-character. *Tapinoma* was always first at the sugar, and swarmed indiscriminately over anything alike.

Diacamma vagans was fairly quick at the sugar, but appeared to be influenced chiefly by the card nearest her nest, and perhaps in some degree by the one with the finest grains.

Solenopsis gemminatus seemed only to blunder on the cards by accident, and without, as far as I could observe, any particular signs of intelligence. *Tapinoma* ate sugar on this spot, and also carried off grains. *Diacamma* carried off the sugar as fast as possible, but ate none. *Solenopsis* ate sugar on the spot, but did not carry any away.

By alarming the ants by striking the cards, shaking the paper, or dropping fine powdered sugar on them, *Diacamma vagans* and *Tapinoma* would give a little start, but, recovering themselves instantly, would seize the nearest and biggest grain, and make off at express speed. *Solenopsis* would start, sometimes tumble over one another, and then make off in alarm and without any method or precision. According to my ideas, *Diacamma*, by a number of little traits which I cannot describe, but which as a whole made a great impression on me, showed the most intelligence, *Tapinoma* the most audacity. *Solenopsis* I do not like to judge rashly from an imperfect human point of view, so will only say I was disappointed with them generally. I never succeeded

in frightening my ants by noise alone; noise had always to be accompanied by an earth tremor or wind.

I several times endeavoured to keep workers of *vagans* in captivity, but never with any success; they swarmed up the sides of my highly polished tin-box with ease, and in my island arrangement, which kept *smaragdina* in perfect security, they found their way with wonderful rapidity to the brick surrounded by the moat, and then took to the water without a moment's hesitation, and with one or two strokes with their legs they got over the two or three inches of water with almost the ease and dexterity of a water-boatman.

On one occasion I put two workers in with *smaragdina*. One escaped at once; the other was seized, but fought her way clear, and followed her companion with splendid determination and quickness. It would require much ingenuity to make a receptacle that would safely and conveniently confine this clever ant.

In Barrackpore Park, on the river-drive half-way between "Scandal-point" and Tittaghur Bridge, at one of the prettiest spots in the most beautiful park in Bengal,—I might almost say in India,—is a fine old banyan-tree (*Ficus indica*), with foliage almost touching the ground; it stands on the green slope below the drive, and the breeze, blowing straight up from the broad Tittaghur Reach, makes the shade of this tree delightfully cool in even the heat of May or June. There is in this spot a stone culvert running under the road, the mouth of it opening in the deepest shade of the tree, and on the stones of this culvert you can find almost all the year round, but particularly in the hot weather and rains, numbers of the workers of *Diacamma vagans* congregated together in couples, and engaged in what I take to be a process of shampooing. Two ants will face each other, and fence about and caress with their antennæ, now advancing, now retiring a little; at last one will give a little spring on to the back of the other, and gently and tenderly hold her with her mandibles; then the caressing with the antennæ is renewed, and the legs are also brought into play, and used in much the same way; and lastly, the mandibles will be run gently up and down the limbs. During this operation the ant under treatment will keep time with her antennæ, and stretch out her limbs with evident

delight and pleasure: there can be no doubt they thoroughly enjoy themselves. You may watch couples in various stages of this process, which is varied at times by three ants taking part, or by one affecting a kind of coy resistance.

I have mentioned that, although *vagans* is a common ant, you cannot find it in large numbers; neither can you start out from your bungalow collecting with an absolute certainty of finding it; but for *ten years* a visit to this culvert under the shade of this banyan-tree on the river-bank always rewarded you with an interesting group of playing, caressing, shampooing ants. During these ten years I only twice found nests of this species within the radius of this banyan's shade or its immediate vicinity, so that, as a rule, my ants must have travelled some distance in order to enjoy and disport themselves in this delightful retreat.*

I must leave my favourite *vagans* now, for I have no more *written* notes, but from numbers of unrecorded observations extending over the years from March, 1872, to March, 1886, I always look back on this species with much affection, and as an old friend who, under any circumstances and tests, has never disappointed me. Judged from a human point of view (which, however, may not be always strictly fair), I certainly place *D. vagans* as the most intelligent ant it has been my pleasure to observe, and I consider *Chlorion lobatum* the most intelligent amongst sand-wasps.

Solenopsis gemminatus, Fabr.

Solenopsis geminata, Fabr.

This species is one of the very commonest in Bengal; you can come across it everywhere. It is the *red ant* of India, as *compressus* is the *black*, and *smaragdina* the *yellow*. It forms its nests, which are very populous, in the ground, under bricks or stones in brickwork, or almost anywhere. It appears to swarm several times in the year from March to October, and I have even

* I could never find out if the ants that frequented this culvert at any one time were all from the same nest, but I am inclined to think, from their numbers and the smallness of the colonies of *vagans*, that sometimes they were not. I have observed this shampooing going on in other similar situations, but never with the regularity and certainty of this favoured spot.

found the winged sexes in the cold weather from November to February. The workers vary greatly in size, some of the workers-major having immensely-developed heads, but you seldom meet these big fellows walking about; they seem to keep to the nest a good deal, and all my finest specimens have been found by opening up a nest. These ants are very fond of forming covered ways from one point of a colony to another, or in crossing a road, and they both tunnel and build up and are very clever in availing themselves of any little irregularities in the ground, by which they can save themselves labour. For instance, on a piece of smooth even ground they will build up a covered way, but if their track comes across a stone they will tunnel under it; if a big brick they will skirt the side of it. They do not completely cover in their ways along the whole line; a great part of the track will generally consist of two walls only. The medium-sized workers, as well as the small, take part in these works, but the giant-headed fellows I have never found engaged.

These ants will come into your bungalows and clear off any loot that may be about, and they seem particularly fond of meat, or any insect you may kill. Supposing you have a flight of cockroaches (*B. orientalis*) come into your room at dinner-time, and in self-defence and to preserve say your soup or glass from being used as a bath you kill one or two, and leave the bodies on the ground, in a very short time, long before you have finished your meal, you will see their bodies apparently become endued with a new life, and travelling at a quite rapid pace across the floor; it is swarms of the little workers of *Solenopsis* carrying off the body to their nest.

In one bungalow at Barraekpore I had a colony in my verandah formed in one of the masonry columns, and divided into two parts, one in the base and one in the capital, and up and down the column between was a continual stream of ants passing. It occurred to me one day to cut off this passage, which I did by soaking a punkah-cord in kerosine oil, and tying it tightly round the centre of the column. The ants on either side soon surged up in masses to within an inch of the cord, but none could cross the oily barrier. I then formed a little bridge with a piece of bamboo, and fixed it in the brick-work, making a clear span over the cord, and the

ends being fixed well in the crowd of ants. I then watched for an hour, but no ants found their way across. I then conducted two or three over, and waited an hour; one of the led ants recrossed, but no others availed themselves of the bridge. I then went for the usual evening drive, and on my return after a couple of hours I found the ants crossing the bridge in numbers. I repeated this experiment many times with exactly the same result. Say barrier fixed at 3 p.m.; bridge erected at 4 p.m., and a few ants led over; at 6 p.m. no ants had availed themselves of the bridge, but at 8 p.m., on my return from my drive or tennis, the bridge would be in general use; but never while looking on did the ants avail themselves of this passage, except as mentioned by a led ant recrossing.

On one or two occasions I captured a worker of *Diacamma vagans*, and placed her above the kerosine cord; without a moment's hesitation she ran up the column to the capital, made her way rapidly through the red ants, then along a beam to the next column, then down to the floor of the verandah, and off to her nest without a pause.

Solenopsis offer many strange contrasts of character; they are very clever in making their covered ways, and in finding their own booty, such as described, but when you apply artificial tests of intelligence they altogether fail, and seem to be strangely slow and disappointing.

Holcomyrme indicus, Mayr.

This ant does not appear to be generally common in Bengal. I have taken it at Nischindipore Nuddea, and in Barrackpore Park, but never in Calcutta or its immediate neighbourhood. It is very plentiful in Barrackpore Park, in the private grounds close to Government House, where it delights in making its nests in the red kunka (ballast) roads, or on any hard dry patch of ground that can be found amongst the grass. The ants swarm early in June, and during the hot months from middle of March to the middle of June you can easily find the nests by the great mounds heaped up round the entrance of empty seed-vessels or husks of grass-seed, I may call it chaff; these mounds will more than fill a pint measure, and I have seen some

which I think would fill a quart. If you watch you will see a continuous but straggling stream of ants disappearing down one of the small round entrances to their nests, each carrying a grass-seed, which they bring from the neighbouring grass, and another stream will be seen emerging with the chaff, which they heap up round the entrance in irregular mounds: when these mounds begin to assume any dimensions the labour of piling up the husks is divided; the ant that brings one out will throw it down just outside, or will mount a short distance up the mound, when another will meet and take on the husk and add it to the top, or when the mound is a certain height, will shoot it down on the far side to prevent its tumbling back on the entrance of the nest. Sometimes three or four ants will be engaged in this process, bringing out, passing on, piling up, and shooting down. The ants bringing in the full seeds collect them amongst the grass, which at this time of the year is dry and ripe, and consequently much of the seed is on the ground. I have never observed them ascending the grass-stems to collect the seed. As soon as the rains commence—about June 15th—the ants seem to disappear, and although you can find specimens about up to October, they are decidedly scarce.

I have tried very many times to unearth one of these nests, but never (except in one instance) with any success. Directly you dig down a few inches in the hard bricky soil you seem to lose all trace of ants and nest. I have tried various instruments—a garden-knife, a long bodkin, and a kourpi (a very handy native tool)—but have always failed; the way the ants disappear is almost like magic. No doubt I ought to have tried a kodali (native spade), but extensive excavations where these ants formed their nests were hardly practicable without obtaining the permission of the Park authorities, which I never took the trouble to do at the time, though now I have left India I never cease to regret that I did not dig down several feet deep and a yard or two square.

The one exception I have alluded to was a very small nest, situated in the viceregal kitchen-garden part of the Park, and where the soil was a sort of stiff clay instead of brick-rubble; the tunnels were very small and fine, and there was nothing peculiar about their formation, but in the centre, a few inches from the

surface, was a small oval chamber, perfectly smooth and dome-shaped; in this were arranged a number of little round seeds, set out like cheese-cakes on a baker's tray. From the habits of this species I should be inclined to call it the "harvesting ant of Bengal." It was described by Dr. Mayr from my first specimens, which were taken at Nischindipore, having been kindly forwarded by my old friend the late Mr. Frederick Smith.

Pheidologeton laboriosus, Smith.

This species can generally be found in the neighbourhood of Calcutta or Barrackpore, but it requires a little searching, and I do not think it would attract the notice of any one but an entomologist. The workers vary most immensely in size, the workers-major running through several distinct grades, and no one who had not observed the nest itself could suspect any connection between the noble, handsome, rich red-brown giants of the first grade with the little insignificant yellow workers-minor. These ants form their nests under bricks, stones, flower-pots, rock-work, or any spot offering shelter and shade of this nature. You occasionally meet with them on the march, probably changing their head-quarters, and when doing so they invariably form elaborate and carefully constructed covered ways. The little yellow workers-minor and the smaller grades of the workers-major you may meet with in the open, but the giant workers I have never found except by opening up a nest or covered way. All the workers are pugnacious, and when handled attack you freely, and the small yellow workers and the smaller grades of the workers-major with some effect, but the giants are perfectly harmless, and it makes one feel quite sorry to watch these huge, brave, conscientious, handsome fellows doing their very utmost to grip you with their mandibles, and doubling in their body, as if with the intention to sting, but with absolutely no result.

In forming their covered ways the workers-minor and the smaller grades of workers-major work together most industriously, carrying and piling up the little pieces of soil with great quickness and dexterity, but I have never observed the giants of the first grade so engaged; they, I think, have a special work to perform, which I will describe.

On the river-drive in Barrackpore Park between Scandal Point and Titaghur Bridge, and close to the latter, I found, in the first week of the "rains" in 1883, a splendid covered way in course of construction across the road, which at this point is about 20 ft. wide. There were a large number of ants at work piling up the little red pieces of soorki (ballast; the soil anywhere about Calcutta or Barrackpore seems to be largely composed of brick and ballast)—and I noticed several of the giant workers also very busy, *not* carrying or building up, but slowly making their way along the line, and here and there stopping and rearing themselves up against the walls, pressing together, and smoothing out in a way which their great size gave them special facility for doing. They used themselves much in the same way as I have seen my mali smooth over the earth with a board when doing a little gardening with belatee (Europe) seeds, or as some of the local rajmistris will also use a board in building a wall. I visited this covered way on a good many successive days, and always found the *giants* busy in this work; they would stand on their hind legs, spread themselves out, and bind together with an even kind of pressure the little blocks or grains of building material. If you picked one up she immediately attacked you in the same thorough, loyal, but perfectly impotent, manner, and when you replaced her she resumed her consolidating form of work. I had (until finding this covered way) often wondered what special use these big fellows served, but I now feel certain this battening process is one. This covered way was cut to pieces and destroyed by the carriages driving up and down every evening, and as regularly repaired by the ants in the early morning. This went on for several weeks, when the ants seemed to pass on, and I lost sight of them. The workers, in traversing their covered way, carried about with them quite an assortment of odds and ends, amongst which I have noticed the larvæ of a Rhyparochromid bug in considerable numbers, sundry other larvæ unknown, a species of weevil, small shells (*Bulimus*) in some numbers, bits of stick or twigs, seeds, head of an ant, &c.

Dorylus (longicornis ?).

Before leaving for India, in 1872, my kind old friend Mr. Frederick Smith gave me specimens of the workers and male of *Dorylus*, and thoroughly imbued me with the necessity of discovering the female, and I started for the East with the most perfect confidence of doing so. On my way across from Bombay to Calcutta I stopped at Jubbulpore to visit the Marble Rocks, and while at dinner at the hotel a male flew in to the light; this was my first introduction to this ant, March 6th, 1872.

I had not been long in Calcutta before I found a very promising-looking nest under a large stone at the bottom of an empty tank on the Alipore side of Fort William. I visited this nest two or three evenings a week for some months, feeling certain that some evening my persistence would be rewarded by finding the ants swarming and capturing the female; but I was doomed to disappointment, for on going to the tank one evening I found the water had been let in, and it was being filled for military purposes. I next took the workers in some considerable number in a purchase of pot-plants made at an auction sale at Mackenzie Lyalls; but my next real nest was at Scandal Point, Barrackpore Park, in the earth, and sheltered by one of the wooden seats which are erected there. I examined it very carefully, probing the burrow with a straw, but, though the workers sallied out in some numbers, there was no sign of a female. I was uncertain whether to dig the nest up then and there, or to watch it for some indication of swarming before disturbing the ants. I unfortunately decided on the latter course, for when I went to the spot the next evening there was not an ant to be seen.

My next nest was found in a small brick culvert leading from the old bear-pit, Barrackpore Park, and was formed under a lot of rubbish made up of bits of brick and decayed leaves. This was a fairly populous little colony, and looked a very likely find, and I visited it for several weeks, until one of the Park malis (gardeners), seized with an extraordinary fit of industry, took it into his head to clear out and tidy up this old drain, which had not been disturbed for years. After this I did not find what might be considered a genuine nest until 1886, but stray lots of the workers could often

be found about the Park, particularly at the back of the lions' and tigers' cages, where the old bones were thrown, and which you could generally count on finding covered with the workers; indeed, an old bone or piece of meat seemed to be an irresistible bait to the workers of *Dorylus*.

The males are never found with the workers, but come into your bungalow at night, attracted by the light, generally at dinner-time, when the lamps being turned up the white cloth forms a special attraction; they come buzzing in and blunder about the room much like a *Scarabæus* beetle, and when handled they work vigorously about with their bodies and clip you with the strong claspers of their genital armature. They are by no means uncommon, but what is very curious is that they usually appear at the end of the cold weather or the commencement of the hot, that is, from middle of February to middle of March, when winged ants of other genera can hardly be found.

My last nest of *Dorylus* was found on the Esplanade, Bombay, on January 29th, 1886; it was my last visit to India, and I was starting for an evening walk, when not a hundred yards from the clock-tower of the University I noticed a strong body of the workers very busy round the entrance to a burrow just at the edge of the turf, and a second glance showed me they had some object in this burrow that they were particularly anxious and jealous about, and, stooping down, I pulled out what from the colouring of the head, legs, and antennæ (so exactly like the workers of *Dorylus*), if I did not actually believe, I at least fondly hoped was the *female*, which I had been looking for for so many years. I rushed back to the Esplanade Hotel, got my collecting-bottle and a knife, returned to the spot, and this time dug up the nest without waiting. I found two more of these suspicious-looking insects, and from the curious, fussy, jealous, and at the same time half-respectful, behaviour of the workers, my hopes as to the genuineness of my find considerably rose. I got three nice little bottles filled with rum, and by the next mail sent them off to Professor Westwood and Mr. Edward Saunders, who kindly wrote me by return of post that my capture was only the "*larva of some Lamellicorn beetle.*" What *Dorylus* does with these larvæ I should much like to know; but my fondest hopes were dashed to the ground,

and after fourteen years of careful search I left India, I fear for good, without finding the female of *Dorylus*.

Lobopelta diminuta, Smith.

This ant is common enough in Bengal, but I have never found any nest; it is always on the march, and moves in lines two deep, and from a few feet to many yards long. The longest column I have met with was in the Botanical Gardens, Calcutta, and measured a little over thirty yards. It marches at a great pace, and seems to prefer shady and damp situations; a number of the workers will always be seen carrying their pupæ with them, which they do by holding them under their bodies, and walking as it were over them.

Lobopelta chinensis, Mayr.

A common ant in Bengal, but only found in small numbers at a time, sometimes only single specimens, and generally crawling about drains or damp shady ground.

Meranoplus bicolor, Smith.

This pretty little species is common in Bengal, although you only find it sparingly as to numbers; it forms its nests in the earth at a depth of a few inches, and these seldom contain more than twenty to thirty individuals. I have only once found the winged sexes in the nest, viz., in May, 1873, in the Eden Gardens, Calcutta, when I took one female and several males (as described and figured in Frederick Smith's paper in the 'Entomological Transactions' of March, 1865). I have since taken one or two specimens of the female, but always singly. The workers walk about singly or a few together, and very much resemble, both in appearance and habits, the females of some of the small species of *Mutilla*; indeed, I have at times captured a worker of rather above the average size, thinking I had something new in that genus.

Plagiolepis gracilipes, Smith.

Query also *Hypoclinea gracilipes*, Mayr.

This ant is common in Bengal, and can generally be found running about between the stems of the smaller

species of bamboo, or behind jaffri (trellis-work), and similar shady situations. The workers are very active, and always seem busy carrying about various species of insects. I have some specimens before me taken with a species of *Pediopsis* (Homopteron) and *Nysius* (Hemipteron), which appear to form a very favourite form of capture.

Aphænogaster.

There are two species of this ant, which are not uncommon in Barrackpore Park in the hot weather; they form their nests in the dried-up grass-covered ground of the open and most exposed positions. One species covers the entrances to its nest with the fallen leaves of the tamarind, acacia, and a thorny shrub like the babool. The other makes tiny mounds of the little pink and blue flowers of a weed that grows amongst the grass; these little mounds, about the diameter of a rupee, and perhaps from one-eighth to one-fourth inch high, are very pretty objects, and from their bright colour easily catch the eye.

Cremastogaster Rothneyi, Mayr.

This pretty little species, which was described from specimens taken in the Eden Gardens, Calcutta, also occurs in Barrackpore Park, but does not appear to be generally common in Bengal; it frequents the trunks of trees, but I never succeeded in finding the nest.

The Mushroom Ant.

There is a species, one of the *Poneridæ*, the males of which come in numbers to light, and settle on the white cloth at dinner-time, or fly about the lamps; it is common from the beginning of the hot weather in March to the beginning of the cold season in November, but I have never been able to find either the workers or females to which it belongs,—that is, *knowingly*. From the very strong smell which it has when handled, and which exactly resembles mushrooms, I have given it the above MS. name.